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ABSTRACT

A curriculum development project began with a market survey to investigate the demand for training in quality assurance (QA). The project objective was to develop a final study program that would cater to a broad range of employees, from operative to senior management; enable employees to appreciate their potential role within a QA system; and have a flexible method of presentation. In response to survey results, a curriculum package was developed that was intended for on-site training, had a target audience of employees from a variety of job functions and with a variety of academic attainments, was flexible, and used a tutor-assisted method of delivery. The final curriculum package consisted of a general introductory curriculum augmented with the study of applications in specific industries to provide an acceptable and detailed working knowledge. Both student-centered activities and case studies were included. The package had essentially three parts: an introduction to quality assurance (six study guides and four case studies), an implementation in detail (two study guides), and quality assurance audits (two case studies). Evaluation was carried out by personal observation, questionnaires, and assessment of tutor-assisted student work in a variety of settings. (YLB)

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QUALITY ASSURANCE

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PROJECT REPORT

QUALITY ASSURANCE

Summary report of a project to develop and evaluate a quality assurance package

Project Leader: Alan Fido
Manchester Polytechnic

Further Education Unit

Professional, Industrial and Commercial Updating

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FOREWORD

This report, from Manchester Polytechnic, suggests that quality assurance (QA) in industry is concerned with all activities and functions involving the attainment of quality, and that it requires the understanding and commitment of all personnel, from management to process workers, from designers to sales staff. The report notes that, in the past, technical aspects have outweighed organisational issues in the provision of QA courses, but proposes that this bias should change in view of the wider adoption of QA systems within industry.

The report describes how a market survey was undertaken to investigate the demand for training in QA, outlining the way in which the needs analysis proved appropriate, and the importance of flexibility in the response to the results of such an analysis. This led to the development of a series of short courses. The material prepared for these courses was adapted as the basis of a set of written and video units to be used in the presentation of similar courses. A preference for on-site courses rather than the use of distance learning materials was identified, and a description of the processes and results of an evaluation of the short courses presented.

The report raises issues on the organisation of curricula, and materials development in general. For example, it states that the educational establishment's market research base is limited to companies who send students on traditional courses, a factor which is particularly relevant when a new or extended market is being researched. It also identifies the problem of making specialist staff available to undertake the development of curricula and support materials when they are fully committed to their primary teaching function. The Project Leader, Alan Fido, Co-ordinator for Continuing Vocational Education and Training for the Faculty of Science and Engineering at Manchester Polytechnic, and his team imply that a system of royalties based on material sales might go some way towards meeting this problem.

The report and the materials developed through the project to which it refers will be of interest to those seeking to provide training in this area. The report also contains useful experience for those preparing PICKUP-type activities more generally. Anyone wishing to comment on the report or on further work necessary in this area is invited to contact Albert Clyde at FEU (tel: 01-934 9402). Those interested in seeing and/or discussing the material should contact Alan Fido at Manchester Polytechnic (see paragraph 14).

Dennis Drysdale
Deputy Chief Officer
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1. INTRODUCTION AND SUMMARY

1. Quality assurance (QA) is concerned with all activities and functions involved with the attainment of quality in industry. It embraces:

— strategy for setting a company's standard of quality;

— specification of technical and human factors which could affect the attainment of a desired product quality;

— control of working procedures, testing procedures, human responsibilities and data collation.

2. These objectives and activities call for the understanding and commitment of all personnel, from management to process worker and from designer to sales staff. To contribute to an effective management system, the objectives must be documented, explained and accepted by all company personnel.

3. In recent years, many more UK companies have been adopting QA systems, as a result of growing pressure from customers. Thus, many more employees could benefit from a study of QA systems within the context of their employment. Such training is necessary not only for quality assurance specialists, but also for other managers whose uninformed decisions may conflict with the attainment of desired quality levels.

4. To meet these needs, this curriculum development project was initiated. The objectives were that any final study programme would:

— cater for a broad range of employees, from operative to senior management;

— enable employees of the various categories to appreciate their potential role within a QA system;

— have a method of presentation which allowed flexibility in use.

5. The stages in the development of the curriculum are listed below:

Stage	*Operation*
1	Conception
2	Regional market survey (questionnaire)
3	Conclusions from the survey, discussed with selected companies and a steering committee

(continues over)

4	Series of (taught) short courses
5	Evaluation of the short courses, contents and learning methods
6	Production of self-/tutor-assisted study texts and case studies (both of which facilitated self-assessment), to provide 60 hours of study
7	Evaluation of study package by employer (the customer) and employee (the participant), by originators and under franchise
8	Refinement of the study package
9	Marketing and (initial) sales to a wider audience
10	Evaluation of delivery, and effective learning at external training centres

6. The market survey identified that on-site training was preferred to distance learning. Consequently, developing a distance learning mode was not seen to be a major objective of the project.

7. This early information about on-site training also implied that the target audience would consist of employees from a variety of job-functions and with a variety of academic attainments. There might be managers requiring an overview on implications and implementation, supervisors requiring help in writing quality procedures, and production workers who might be unsure of their role and responsibilities in relation to QA. Collectively, they would need a common vocabulary if there were to be a concerted operation.

8. This broadening of the project brief further implied a flexible curriculum and a tutor-assisted method of delivery. A variety of learning methods was used, and the experience showed that company-related activities which called for the application of concepts using group discussion were particularly effective and applicable to a mixed-target audience. This experience guided the project towards including student-centred activities and case studies in the ultimate study package.

9. They also showed that potential customers wanted training on organisational matters rather than technical background. It became obvious that the technology was best incorporated as a contextual framework for the understanding and application of quality policies and procedures. This meant that a general introductory curriculum needed to be augmented with the study of applications in specific industries to provide an acceptable and detailed working knowledge.

10. Evaluation was carried out by personal observation, questionnaires and assessment of tutor-assisted student work in a variety of settings.

11. Control of the project operated on two levels. A steering committee was drawn from industry, education and training institutions, and the FEU and DES. This committee gave guidance on policy and evaluated its implementation. An internal planning committee drew up detailed objectives and controlled preparation of curriculum materials. In practice, the day-to-day management of the project was resolved by liaision between the subject teams and the Project Director.

12. The project staff were mostly drawn from different departments of the Polytechnic and from industry. There were problems in arranging for the release of specialist staff from teaching, although the development and evaluation of the curriculum and its subsequent transfer to FHE courses proved to be a valuable staff development exercise.

13. The curriculum package developed has essentially the following three parts (for further details see Appendix A):

An introduction to quality assurance
(a) Six study guides incorporating assignments and answers:

The need for quality assurance	(Text and videotape)
Quality and the manufacturer	(Text and videotape)
Quality costs	(Text and videotape)
Specifications and control of quality	(Text)
Quality systems to BS 5750	(Text)
Product liability	(Text)

(b) Four case studies with discussion assignments:

Recognising the needs	(Text and videotape)
Implementing the system	(Text)
Controlling materials	(Text and videotape)
Audit in a light engineering company	(Videotape)

An implementation in detail
Two study guides:

Quality assurance and design	(Text)
Plans, programmes and procedures	(Text)

Quality assurance audits
Two case studies with discussion assignments:

General engineering	(Text)
Construction industry	(Text)

14. Further details and inspection copies of these materials are available from FEU Local Information Centres. The material may be purchased from Manchester Polytechnic in total or as individual packs (contact Mr A T Fido, Co-ordinator of VET, Faculty of Science and Engineering, Manchester Polytechnic, John Dalton Building, Chester Street, Manchester M1 5GD (see also Appendix C)).

2. THE MARKET SURVEY

The formative phase

15. The exploitation of new technology in the production of goods has reduced the part played by manual skills. Consequently, that element of manual skill which might have made allowances for shortcomings in design, machine performance and material behaviour is not now available. Thus, it should be recognised that new technology requires changes in roles and procedures to ensure the quality of manufactured goods.

16. The essential role of education and training in the process of change has been supported by papers in the technical press[1], which emphasised that management training, particularly in relation to policy formulation, was a key to a thorough and effective quality assurance system. This was supported by a survey of British workers[2], which indicated that adequate training in quality assurance methods was needed to develop the necessary attitudes.

17. British Standard 5750 was published in 1979, and the first steps in shaping the Department of Trade and Industry's National Quality Campaign were taken in 1980. By 1983, this included a Register of Companies which possessed certificated QA systems.

What was available?

18. Courses of study leading to membership of the Institution of Quality Assurance were available. These consisted of day/evening or evening-only attendance, with some 300 to 400 hours study. Only one such course proved to be viable in the North-Western region. It was clear that there was a mismatch of perceived need and response to the training available. All existing provisions saw the employee as the customer, yet the prime need, and any benefit from answering it, was that of the employer. Consequently, it was decided to examine the view of employers.

The questionnaire — distribution and response

19. Questionnaires, together with covering letters which explained the objectives of the project and offered further explanation, were despatched by post to 83 companies in the North West of England. These companies were selected from existing polytechnic mailing lists and represented a range of sizes and handled a wide variety of materials. A reply was requested within three weeks.

20. To seek to increase the responses, a random 50% of the companies were contacted by telephone within one week of despatch of the questionnaires.

After the expiry of the deadline telephone calls were made to any company which had not replied in order to prompt the return of the questionnaires. Figure 1 compares the level of response for the two groups.

Figure 1

'Contacted' batch		'Non-contacted' batch	
Number despatched	42	Number despatched	41
Initial returns	19 (45%)	Initial returns	10 (24%)
Additional returns	4	Additional returns	3
Total returns	23 (54%)	Total returns	13 (32%)
Combined total returns 36 (43%)			

21. A copy of the full questionnaire is available from Manchester Polytechnic (see paragraph 14). It may be summarised in three parts:

— Part A aimed to establish the size of the company and the nature of its manufacturing operations.

— Part B enquired into the company's organisation for quality control, the level of quality to which it worked and whether it operated to any externally specified quality assurance systems. Where possible, definitions from the British Standards were used.

— Part C was designed to establish whether the company recognised a need for training, the target audience, the mode of provision preferred by the company and the subject content.

The questionnaire — analysis of responses

22. A detailed analysis of the responses is also available from Manchester Polytechnic. The following paragraphs summarise the questions raised, the main information in the replies, and interpretation and implications for the ensuing stages of the project.

Company operations

23. The range of company sizes was biased towards those companies with more than 300 employees. On reflection, the lack of companies with less than 50 employees was not surprising, since such companies rarely had registered students and thus were not a common category in the polytechnic records.

24. An educational establishment's market research base tends to be limited to those companies who send students on traditional courses, and personal staff contacts. This becomes relevant when determing target groups for surveys of this type, especially if a potential new departure or extension of a market is being examined.

25. Since the companies surveyed already appreciated the importance of technical/higher education for their employees, it was not unexpected that only three did not have a quality control department. More importantly, this meant that the less technically aware companies had not been surveyed by the sampling method used.

26. Fifty-two per cent of the companies had a quality system which required procedures for control and inspection throughout manufacture and installation. Approximately 10% were concerned with the design of products and required the quality system to control this function. Eighty-three per cent were already subject to quality audits by major customers.

Target audience

27. Out of 36 companies, 34 who responded indicated that there was a need for training in the subject of quality assurance. The responses suggested that training was required for people involved with job functions centred on production, quality control/assurance, design, purchasing and marketing. Similarly, the responses also suggested that middle managers, supervisors and operatives need to have a working knowledge of quality assurance methods. The number suggesting training for senior managers was relatively low.

Course content

28. The suggested topics were grouped into two sections, the first section providing foundation studies and the second dealing with aspects of QA. The order of support for the topics to be included in any training course is given in figures 2 and 3.

29. There was support for some foundation studies subjects but not for those which are often associated with academic syllabuses. The overall preference was for those QA topics which would translate the statements of BS 5750 into working management and administrative practices. The majority of companies were concerned with QA issues relating to manufacturing, installation and final testing. There was support for examining the relationship between design and quality assurance, but perhaps as a second stage of development.

Figure 2: Order of support — foundation studies

Subject	'Engineering' companies	'Materials' companies	Total
Source of defects	16 (73%)	9 (75%)	25 (74%)
Measurement, metrology and calibration	16 (73%)	7 (58%)	23 (68%)
Presentation of data	11 (50%)	9 (75%)	20 (59%)
Mathematics of statistical methods of quality control	10 (45%)	7 (58%)	17 (50%)
Science of destructive and non-destructive test methods	10 (45%)	6 (50%)	16 (47%)
Manufacturing process technology	8 (36%)	4 (33%)	12 (35%)
Properties of materials	5 (23%)	3 (25%)	8 (23%)
Maximum no. of companies	22	12	34

Figure 3: Order of support — QA subjects

Subject	'Engineering' companies	'Materials' companies	Total
Quality assurance concepts	18 (82%)	12 (100%)	30 (88%)
Quality audits, review and evaluation	16 (73%)	12 (100%)	28 (82%)
Documentation	17 (77%)	10 (83%)	27 (79%)
British, international and company QA standards	15 (68%)	10 (83%)	25 (74%)
Management objectives	15 (68%)	10 (83%)	25 (74%)
Quality programmes	17 (77%)	7 (58%)	24 (70%)
Defect and failure analysis	15 (68%)	9 (75%)	24 (70%)
Control in design, purchasing, production, etc.	16 (73%)	6 (50%)	22 (65%)
Statistical methods of QC	11 (50%)	9 (75%)	20 (59%)
Product liability, safety legislation and insurance	11 (50%)	8 (66%)	19 (56%)
Destructive and non-destructive test methods	11 (50%)	7 (58%)	17 (50%)
Statistical analysis of process variables	7 (32%)	8 (66%)	15 (44%)
Microcomputers in control and QA	6 (27%)	3 (25%)	9 (26%)
Maximum no. of companies	22	12	34

30. A notable outcome was the low interest in statistics and computing, although these are commonly assumed to be at the core of quality control. Companies with batch production of high-unit-cost products might not be so convinced, and these represent a large proportion of regional industry. Discussions suggested that the potential of these topics was recognised, but that knowledge requirements for formulating a quality assurance strategy, tactics and attitude were of overriding importance. Once QA systems have been commissioned, managers may well wish to explore the use of statistics and computers in the context of QA, and operatives may require more familiarity with them.

Course delivery

31. Most support was given for group instruction on the company's own premises. Daytime operation for half to one full day per week was preferred. This is distinctly different from the traditional patterns of evening attendance at a college. Minimal interest was shown in the self-study mode.

32. Discussions were held with selected companies, where the questionnaire had indicated a broad interest in QA and related training needs, to explore the issues in greater detail.

33. Managers were not chiefly concerned about how much new knowledge their employees had picked up from a course, but expected that content should be task oriented and aimed at the refinement of the students' skills.

34. Assessment is a difficult area, requiring research and negotiation between employers and the trade unions. If adult training is to be a vehicle for change, then trainees will need assessment and accreditation so that they and their employers can benefit from reliable standards.

35. The Steering Committee considered the analysis of the survey responses, the limited resources available and the urgency of the need, and decided that this would best be answered by courses based on the subjects receiving most support in the survey. These were:

— Quality assurance concepts
— Quality audits, review and evaluation
— Documentation
— British, international and company QA standards
— Management objectives
— Product liability

36. The Steering Committee advised that the testing stage of the project should mainly be carried out through on-site courses, in half-day sessions, the content being drawn from the above menu according to company needs. Each course would be used to explore, *inter alia*:

— the use of audio-video materials;
— task-oriented learning;
— the implications of having middle managers, supervisors and operatives present in the same audience.

37. It was agreed that the project team would also need to produce a comprehensive set of flexible learning materials.

38. The lack of interest in how computers might be of benefit to a quality assurance system has already been noted. Because it was felt that immediate pressures could be hiding a latent need, the Steering Committee also decided that this subject should be explored further. This has been reported elsewhere[3].

39. A newsletter was produced, outlining the main conclusions of the needs analysis, and sent to all recipients of the questionnaire. It also made proposals for a series of short courses, the contents of which would be based on the questionnaire responses but tailored to individual company requirements.

3. TRIAL-TESTING OF THE CURRICULUM MATERIAL

Pilot short courses

40. A pilot short-course programme was organised to:

— enable a core of material to be assembled quickly;
— facilitate continuing refinement of the syllabuses;
— establish the relevance of the approach to industry-based course members;
— provide a method of evaluation through questionnaires and direct feedback from students;
— gather information on the acceptability of student-centred learning for post-experience courses;
— collect examples of QA practices and case histories through direct contact with industry.

41. A series of target dates was set for staff who were formulating study material for what was, to all intents and purposes, a new subject area. This was especially important when those staff had no formal experience of producing packaged learning material.

42. Seven companies asked for discussion on the provision of a course. Two visits to a company were usually required before both provider and client were happy with the intended content.

43. It was recognised that a variety of learning techniques would be required since the potential audience would probably lack recent experience of formal learning. Variation of technique would avoid the need for more than one tutor per session, which was an important consideration in calculating operational costs. Particular attention was given to the specific skills the employers had identified as valuable. It was decided that individual assignments followed by group discussion would be one effective learning method. Teaching schedules aimed to progress from general examples to company-based case studies.

44. The involvement of senior managers as tutoring staff or course members was encouraged as it assisted integration of company staff and led to more informed discussion. To facilitate discussion, group size was limited to 12.

Evaluation of short courses

45. A more detailed report is given in Chapter 4, but certain features are recorded here to explain the progression of events.

46. Each participant was asked to complete a questionaire. Judging by the responses stated in figure 4, the courses met the expectations of the participants. The results also appear to show that proficiency improved over the period of operation.

Figure 4: Overall acceptance of the taught short courses (January 1983 — September 1983)

Course	1	2/3	4	5	6	7
No. of respondents	9	10	4	12	10	12
Would recommend a colleague to attend	66%	90%	100%	100%	100%	100%
Would recommend a colleague to attend in the evenings, voluntarily	44%	40%	50%	75%	50%	75%

47. Equally important was that participants favoured a combination of audio-visual learning materials and student-centred tasks. Where a group was of mixed educational attainment, those with a low level of technical education made a useful contribution in discussion and were not overawed by the presence of more academically qualified personnel.

48. For the project team, the courses:

— confirmed the initial conclusions of the market survey;
— established the level of concepts which could be understood by audiences containing a variety of personnel;
— showed the importance to learning of student assignments and structured discussion;
— confirmed that a curriculum with a company-specific orientation was an important element in encouraging learning.

The production of a study package

49. Consequently, it was decided to produce a set of tutor-assisted study texts and case studies based on the material tested, which would provide:

— detailed syllabuses for trainers who did not have an exact understanding of quality assurance and its relationship with engineering;
— study guides for middle managers and supervisors;
— a curriculum which could accommodate participants with a range of educational backgrounds, using a blend of self- and tutor-led study;

— a strong audio-visual presentation mode;
— learner-centred, self-assessment activities which facilitated discussion;
— a background of realistic engineering situations calling for the understanding and judgement associated with developing and operating a quality assurance system. These would consolidate understanding and possibly provide assessment excercises.

50. After following such a study programme, employees would be expected to understand the benefits of a quality assurance system and their own vital part within that system.

51. A draft package, in text and videotape formats, was evaluated, amended and then produced for sale as a tutor-assisted learning package. It essentially extended the topics of the short courses and could support some 60 hours of study. Study Guides 7 and 8 and Case Study 2 were added subsequently, to complete the priority topics suggested by the market survey. An outline of the package is given in paragraph 13. Appendix A contains a detailed list of contents.

Texts

52. Academic staff were used to write the texts, to ensure a combination of writing ability and broad subject expertise, with experts from local industry being employed as consultants to provide specialist knowledge.

Case studies

53. Six case studies were produced, with the general aims of:

— supporting open access courses by providing a realistic simulation to enable students to apply the concepts presented in the teaching units;
— being free-standing resource material, to allow some flexibility in compiling study programmes;
— providing a means of assessing students by incorporating assignments for tutor marking;
— demonstrating specific concepts related to a particular industry or aspect of preparing a QA system.

4. EVALUATION OF THE CURRICULUM

Framework

54. In assembling a learning package which could be disseminated to trainers, the curriculum and its production was evaluated over two stages:

— during the operation of seven short courses using a lecture/tutorial delivery supported by 'off-the-shelf' audio-visual materials;
— when the fuller curriculum became available.

55. It was intended to explore the:

— extent to which the curriculum provided a coherent and useful body of knowledge;
— relevance of the curriculum to a range of target audiences;
— quality, effectiveness and acceptability of the learning and delivery methods, especially those related to individual assignments, group discussion and simulation;
— extent and recognition of individual learning;
— organisational and administrative practices for the conducting of post-experience vocational education (PEVE).

56. The methods used to undertake the evaluation included:

— commentary by the tutors;
— questionnaire for participants;
— assessment of assignment answers;
— discussion with managers after some months had elapsed;
— critique by the Steering Committee.

Syllabus and target audience

57. The syllabus, which evolved during the initial short-course stage and was subsequently expanded in the learning package, was given general approval by:

— the on-site audiences;
— the workshop of industrial engineers and consultants;
— the Steering Committee;
— the QA managers;
— the tutors.

58. A statement of the syllabus is given in Appendix A. It is aimed particularly at those whose job requires a working knowledge of quality assurance, but

covers only part of the function of someone employed full-time in a quality assurance department. Trials have shown that the learning material can be used successfully for middle managers, supervisors and operatives/tradespeople in employment.

59. When first defined for the project information bulletin, the course was for 'industrial personnel'. The needs of those with limited educational backgrounds were to be met by making foundation studies available. Subsequently, the market survey suggested that middle managers and supervisors should be the main audience. They would not necessarily be employed in a specialist quality assurance department, but might be from any other branch of the company. The requirements of the mixed clientele had been allowed for by careful compilation of the study material, and tutorial support where necessary.

Learning methods and materials

60. A number of learning methods were used and participants were asked to comment on each. Where the presentation required participation by the audience, there was a 'good' to 'very good' response. Participation leading to group discussions received a 'very good' response from all the audiences.

61. It was widely agreed that activity and discussion topics should be based on actual company operations. On the company-based course, there was an opportunity for participants to criticise company organisation in a constructive fashion! Appendix B gives an example of how having simple data available can avoid abortive discussion. Compiling and comparing the results of each group's discussion is an effective way of reaching overall conclusions.

62. The learning package incorporates tutor assistance because early experience suggested this permitted flexible study programmes that were capable of adaptation to varying company requirements to accommodate differences in product, process and audience mix. This delivery mode received a 'good' to 'very good' response from participants.

Company facilitators and tutors

63. During one in-company course, managers were clearly stretched by the new experience of guiding a discussion group. However, after training, they proved to be key catalysts in the company training strategy. By facilitating discussion on training and educational aims, they were able to develop a sense of greater relationship to the workplace and increase the learning rate amongst the workforce.

64. Line managers being trainers is not a new concept. This brief enquiry supports the similar view expressed in *Direct Trainers*[4]. The practice is not widespread, but could have particular benefits in small and medium-sized companies. Support is required in terms of:

— pedagogic skills;
— tutor packs with learning packages to permit variation of academic depth and relevance;
— access to local education establishments.

Self-study time and place

65. The in-company course had intermittent self-study periods, during which 82% of the participants sought discussion of the text with colleagues in general. However, 72% thought it would be worthwhile to have short visits from a tutor or a colleague, designated and trained as a facilitator for tutorial and discussion groups.

66. For this trial:

— individual periods of self-study were half to one hour in length on each study guide;
— 70% of participants studied at home.

The lengths of the self-study periods were similar for the 12 participants who responded.

67. The total time for personal study was determined by;

— mental stamina;
— the point of self-determined understanding;
— the start of another equally important activity.

The last was the dominant factor. Study occurred 'in a lunch break' or 'before the family wanted the television switched on'.

68. The market survey did not anticipate any self-study at all by waged employees outside the classroom. The fact that 70% of participants chose to study at home was therefore significant. From the fact that higher education students in the trial spent two to three hours on each study guide, it might be assumed that the company employees did not reach an adequate understanding. These results are meagre, but they do show that planning for periods of self-study greater than one hour could prove incompatible with the timetable (or stamina) of employees.

Learning outcome

69. The extent of individual learning at the completion of the study programme is one measure of success, but the longer-term effect of application at the workplace is the ultimate assessment that should be made. Attempts were made to gather information at both stages, to a limited degree, to guide further development of the learning package. A high proportion of course participants was prepared to compile and submit answers for assessment. However, it was found that assessments using a multiple-choice technique were preferred.

Effects at the workplace

70. Discussions were held with two managers, up to one year after their employees had undertaken a taught short course, to probe such factors as:

— changes in the employees' general attitude;
— acceptance of a new QA system;
— evidence of better working practice;
— indirect financial benefit;
— indirect effect on customers of the company.

71. In the opinion of the managers, the provision of a tailored course by the employer increased the commitment of employees to improving working practices. This provided:

— the confidence for hourly paid staff to question changes in working practices where they felt criteria such as delivery date were in conflict with quality of design and conformance levels;
— acceptance that the new management system made their job easier since they could interpret the new documentation.

72. Some of these changes and improvements could have occurred without a training programme. Training offered more comprehensive and faster learning and:

— at least 50% of the personnel understood and accepted the new QA system on completion of the study programme;
— a further 30% accepted the system in discussions following the study;
— co-ordination between departments was improved, especially between the production departments and non-production departments such as sales, contract and design.

Aspects of preparation for courses

73. The preliminaries to presenting a course outside the traditional classroom can play a part in the effectiveness of the learning process. Some observations of general circumstances are recorded here, although this aspect formed no part of the experiment.

74. It was found to be preferable to commence the course immediately after an official work break period. It was also found that an improved standard of accommodation and a change in wearing apparel contributed to the noted increase in participation.

75. Factors such as these, at moderate costs, can be used to reinforce the workforce's impression of the importance senior staff attach to training.

The implications of group discussions

76. The achievement of a session's objectives can be limited by:

— the initially inadequate skills and confidence of some personnel;
— inappropriate grouping of personnel.

77. Observations showed that an inappropriate grouping resulted in:

— 'the blind leading the blind';
— inhibitions and embarrassment;
— the tutor being unable to generate participative discussion.

78. Reorganising the groups and incorporating a suitably experienced member of the company staff in each group as a facilitator enhanced wider participation in discussion. Groups of four or five proved to be the optimum size.

79. The room should allow for seminar groups to be formed, from the outset, by a seating plan with named places, to avoid disruption when commencing discussions.

Consulting the company on discussion topics

80. Consultation should be held with the company, prior to the commencement of training, in order to provide assistance leading to effective group discussions. The company should:

— provide background data;
— be willing to implement constructive ideas that arise from the discussion groups.

81. Checklists for providers and managers could promote more effective preparation for a course during pre-course consultation. Further development work should include this objective.

Evaluation — resources, strategies and companies

82. The use of more than one evaluation method permitted some cross-checking. Overall, the variety of audiences making successful use of the learning material showed that it could form the base of programmes for audiences with wide ranges of prior knowledge and abilities.

83. All stages of the evaluation contributed to the revision of study guides and case studies. Measurements of learning highlighted ambiguities and enabled the refinement of learning objectives. The workshop identified forthcoming support from local companies, and methods of increasing flexibility and widening the potential audience.

84. To judge how resources might best be used in terms of the syllabus, target audiences, delivery methods and potential markets, the workshop probably provided the best compromise.

An evaluation of support services

85. Preliminary enquiries suggested that experience in the evaluation of learning was sparse and tended to be restricted to teacher training and traditional higher education. Advice on techniques and tactics for the evaluation of study programmes aimed at post-experience 'in-company' courses was not readily available.

86. A strategy for evaluation of PEVE-type learning materials and programmes, which have no external validation process, should be determined in stages:

— publishing a summary of research findings relevant to the evaluation of provision for PEVE;
— preparation of advice, information and methods, for the use of project teams, which evaluate new learning provisions;
— co-ordinating the evaluation across adult training projects to ensure a full picture of learner influences, methods relevant to the adult employed, and assessment of change due to learning;
— testing the cost, advantages and disadvantages of means by which external views can be incorporated;
— dissemination of information from the market-place to intending providers of training.

The currency of an evaluated course

87. In this exercise, it has been assumed that the employer is the customer and the employees are the students. The customer will wish to judge the learning package prior to purchase. An assurance of a high standard is, therefore, an important aspect of marketing policy.

88. Evaluation is a necessary element of any curriculum development exercise, but self-evaluation does not necessarily mean recognition by a potential customer. However, an evaluation process involving representatives of, or accreditation by, external bodies, and using approved procedures, could aid recognition. Recently, there has been more flexibility on the part of bodies such as BTEC and C&G to accredit courses such as that developed in this project. The establishment of NCVQ may increase the opportunities for course recognition. An alternative form of recognition may be gained by the institution being a member of the 'National Training Index' (6 Hanover Street, London W1R 9HH), a course listing being obtained as a result of external evaluation.

APPENDIX A: AN OUTLINE CURRICULUM FOR TRAINING IN QUALITY ASSURANCE SYSTEMS

Aims and value

More order, less waste and, thus, more profit are the reasons for paying attention, through training, to the personnel who make a quality assurance system work. This training programme is intended for companies wishing to work to BS 5750 and requiring their workforce to be conversant with it.

There is a rapidly growing trend for customers to purchase only from QA approved companies. In many cases, large and medium-sized companies are passing on requirements of their own major contracts, as vendors, to nationalised industry.

Successful quality assurance systems depend on all the workforce understanding and recognising their part in assuring quality.

The curriculum content is relevant to personnel from production, inspection, sales, technical control, buying and general management.

The syllabus content is intended to balance the emphasis sometimes given to inspection and quality control. What is learnt and transferred to the workplace will depend on the study time, amount of tutorial help and programme content. Participants, having followed the guidance and self-assessment stages of the programme, should:

— understand the jargon and procedures of a practical QA system;

— recognise that a QA system is a cost-effective total management system which underpins customer confidence and profits;

— have a constructive attitude towards a company's quality programme;

— be able to operate within a system and possibly initiate or amend a system;

— prepare quality system documents.

Context and content

The titles, topic areas and suggested minimum study times are as follows. The learning programme should meet half the objectives in BTEC level IV/V units on Quality Assurance.

Unit 1 *The need for quality assurance* 1-2 hours

This introduces the concepts of Quality Assurance from the viewpoint of the product function and the customer. Particular emphasis is placed on product design, components of quality systems and the auditing of quality (Study guide and videotape).

Unit 2 *Quality and the manufacturer* 2-3 hours

The concepts of 'quality' are studied to demonstrate the complementary nature of management policies, market research, manufacturing operations and customers' requirements. The important distinction between quality due to design and quality due to conformance with specification is stressed (Study guide and videotape, 'Introducing Harold Slater', supplied by the Department of Trade and Industry).

Unit 3 *Quality costs* 2-3 hours

Quality costs are analysed in relation to the 'design' and 'conformance' concepts of quality introduced in Unit 2. The role of management in controlling costs is considered, and the philosophy of 'making it right first time' is emphasised. The Part 2 document includes a discussion showing the relationships between costs of failure, appraisal and prevention (Study guide and videotape, 'Introducing Harold Slater').

Unit 4 *Specifications and control of quality* 3-4 hours

The importance of precise specifications is studied initially in relation to the need for control of processes. A case study is used to show the reader how control systems must reflect the needs of particular industries. Part 2 presents examples of control philosophies in varying types of industry.

Unit 5 *Quality systems to BS 5750* 4-5 hours

This unit considers the aims of BS 5750 and compares the levels of application of the three parts. The uses of quality manuals are discussed, and the components of a quality system for an engineering factory are developed. The unit contains activities designed to give familiarity with BS 5750 Part 2, and the differences between Part 2 and Parts 1 and 3 of BS 5750 are studied.

Unit 6 *Product liability* 5-8 hours

This unit explains the essential legal terms and practice related to manufactured goods and engineering services. It differentiates between merchantable quality and fitness for purpose. Supplier and customer responsibilities are examined

through a series of assignments. The importance of items such as documentation, sampling, product manuals and guarantee statements are considered.

Unit 7 *Quality assurance and design* 10 hours

After relating the requirements of BS 5750 Part 1 to the daily activities of design and their implications, the unit introduces the procedures necessary for control of these activities. An audit then examined several aspects of design office operation, in detail, to provide experience in identifying inherent pitfalls. The importance of quality design in underpinning quality of conformance is emphasised.

Unit 8 *Plans, programmes and procedures* 10 hours

A manufacturer is invited to tender for aspects of design, manufacture and testing of an item of capital plant. Evidence is presented of the existing quality system and documentation. By examples and assignments, the reader is guided in the drafting of job procedures, quality plans for part of the work programme, and a quality programme for the specific contract.

Case Study 1 *Recognising the needs* 2-3 hours

This case study presents on videotape the products, processes and testing procedures of a fabrication company before the introduction of a QA system. The student is required to assess which level of the BS 5750 system is relevant and which areas require formalised procedures in the quality manual.

Case Study 2 *Implementing the system* 2-3 hours

The case study considers the key personnel in the successful implementation of QA at the company. The student is led to consider the most effective ways for the system changes to be introduced, and the need for the company organisation to reflect the importance of quality.

Case Study 3 *Controlling materials* 2-3 hours

A materials control system is taken as a basis for a workshop exercise on BS 5750. The student is required to examine the British Standard to ascertain which paragraphs are being contravened in the first section of videotape. After the student has made recommendations to improve the system, the second videotape section demonstrates the changes the company has made.

Case Study 4 *Quality assurance audit — general engineering* 10 hours

Based on the batch production of values, this dialogue of a detailed audit emphasises the importance of documentation, specification, authorised responsibility and traceability. By inviting the reader to find the shortcomings in a reasonably well-organised system, it both demonstrates the essentials of control and the pitfalls of normal works practice. Beginning from the order arriving in Sales, all departments are represented through to test and final despatch.

Case Study 5 *Quality assurance audit — a civil engineering and site operation* 8-10 hours

The contractor is building a large reinforced concrete structure, service buildings and site roads. Thus, the audit examines both mass reinforced concrete construction and conventional building techniques, and demonstrates the framework of a quality assurance system at the head office and site. It also raises questions particular to civil engineering and building, such as control of local vendors, storage on site, responsibility for operations in remote locations, testing, and the use of results. The form of presentation allows the use of evidence from discrete office or site operations to support the study guides as necessary.

Case Study 6 *Instrument manufacture*

Not yet published — contact Manchester Polytechnic for information.

Case Study 7 *Quality assurance audit — general engineering (videotape)*

The aural and visual evidence of a pre-audit visit to the company invites the viewer to identify cases of non-conformance with a BS 5750 quality assurance system. It explores goods receipt, purchasing, material control, machining, inspection and training.

Study programmes

The learning material and programmes must be flexible to allow variation of learning methods and a study content relevant to the needs of individual people and companies.

Individual study is possible, but periodic discussion in small groups will greatly aid understanding, subsequent collaboration and attitudes.

Assignments, with written answers provided for plenary sessions, should be used to consolidate and broaden learning. Different, yet valid, answers will arise for the same questions. Students need to recognise and accept this.

Where participants are not used to providing written answers they may provide no answer at all, even though, as we know from experience, they can provide a clear answer orally. If a written form of answer is not essential, then discussion answers should be translated into multiple-choice or yes/no formats. Assessment will then be possible, but sentence construction will be avoided. This technique will also permit the question and answer to be tailored to company and industry context.

Where it is desired to limit the length of study, we suggest the following elements according to job function:

Supervisors and managers who need to collaborate with a QA manager in devising traceability documentation, quality procedures and quality plans.

Study Guides 1 – 6 and 8 (1 – 3 for general manufacturing staff)
Case Studies 1 – 3 and 7
Case Study 4 or 5 (or subsequent productions more related to their specific industry)

Managers who need an insight into the justification and operation of QA when deciding company policy. There is much evidence that when senior managers ensure they understand the purpose of a QA policy, the whole programme has a greater chance of success.

Study Guide 1 and preferably 1, 2 and 3
Study Guide 6
Case Study 1 or 7
Case Study 2 (which includes typical steps for introducing QA to a small company)

Quality department staff needing further insight into specific practice and self-assessment of their auditing technique.

Study Guides 6, 7 and 8
Case Studies 2 and 3
Case Study 4 or 5 (or subsequent publications more related to their specific industry)

New recruits to specialist QA roles will benefit from studying the whole programme.

Sales and buying staff
Study Guides 1, 2 and 3 (Part 1), possibly 6
Case Studies 7 and 4 (Section 1)

APPENDIX B: THE USE OF DATA TO ASSIST DISCUSSION

Introduction

This is a simple example of a progressive discussion during the 'in-company' evaluation. It is recorded here to indicate:

— how emotion can stifle discussion;
— how a manager can find it difficult to be constructive and dispel emotion;
— how relevant company data can make discussion very much more meaningful.

Stage 1

a) The group was asked to select a recent fault in a component/manufacturing operation, log all the elements which cost money, and apportion them to quality of design or quality of non-conformance. This analysis was then to be used to examine corrective action.

b) The group chose the fitting and wiring of an electric motor to a compressor in a star delta configuration. On testing it was found that, although wired correctly, the motor would not work. It had an identification plate signifying it to be the correct type of motor but, in fact, it was of the wrong type.

Stage 2

a) The group correctly listed the cost elements as labour for the fitting, wiring and removal, but forgot the labour cost of an abortive test, subsequent inspection, and negotiation with the supplier for a replacement.

b) The latter element was then identified as 'work for those in the office who should have noted the error anyway because they deal with the paperwork', to which the manager replied, 'Well, we get the exchange free of cost and the office staff could not be expected to check technical features such as the design of an electric motor. After all the motor bore the correct design number'. A difference of opinion then began to form on the well- known line of the 'shop floor' versus the 'office' overheads cost.

c) The tutor, trying to steer a course back to rational discussion, made the interjection that the key questions were, 'Should it have been checked according to the present control systems? If so, who should have checked it before installation commenced?' If the answer was no to the first question, then 'Was it worth instituting a "goods-inward inspection procedure" (or an alternative corrective measure)?'

d) 'No, there was no checking procedure' and the manager opted for supporting a 'goods-inward inspection procedure', to which a particular shop floor tradesman responded emotionally that here again was another non-productive job adding to the overheads. The manager struggled to find an explanation for what he knew was common sense, but no focus and resolution emerged.

Stage 3

a) The tutor suggested the question 'Was it worth it?' was the logical step, which in turn begged for numbers to be given to the cost elements already identified.

b) The manager freely gave the necessary figures from memory, including the total cost of the failure (£18). A check of incoming motors to a prescribed procedure would take five minutes at a total cost of £0.50 each.

c) Everybody readily agreed, without emotion, that it would be worth having a check in the system and that it would contribute to efficiency in production by reducing manufacturing costs.

There would be other solutions to the problem and more detailed analysis would be required, but all had learnt that:

— they were capable of analysing it together and, therefore, more thoroughly;
— they should analyse present performance — quantitively;
— there were simple, better procedures for some of their operations.

Prompts on useful data and key questions to catalyse a discussion, associated with a particular activity/assignment in the study guide, would be one form of entry in a tutor/facilitator pack.

APPENDIX C

QUALITY ASSURANCE

Don't be left behind . . .
put your workforce in front
through training support on
quality systems —

Administrator — Quality Assurance
Room E227
John Dalton Faculty of Technology
Manchester Polytechnic
Manchester M1 5GD

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People make a quality assurance system really work, training them can achieve the goal of less waste, more orders and higher profit. Our training programme is intended for companies wishing to work to BS 5750. It particularly relates to companies in the early stages of their quality programme or where staff turnover necessitates periodic training.

The Learning Material consists of study guides and case studies, in both text and videotape format, designed to minimise the need for face to face tutorials. It is based on courses and projects operated for local companies with the collaboration of industrial quality assurance specialists. The format allows variety in presentation and the use of tutors from a company, a local college or Manchester Polytechnic itself. Total self study is also feasible. Assessment questions with guidelines, discussion answers aid group discussion and personal understanding.

Colleagues outside the QA department, whether manager, foreman, technician, operative or clerk, make a quality system work. Our training material will give them a working knowledge of a quality management system. Smaller companies often new to QA, unable to sustain a separate specialist QA department, needing to remove the mystery of the jargon and assess the detailed needs of a QA system will find the programme useful.

Manufacturing Industry Personnel from sales, production, inspection, technical control, buying and general management have already found the study programme helped them to:

Understand the jargon and procedures of a practical QA system.

Operate within a system and possibly initiate or amend a system.

Have a constructive attitude towards a company's quality programme.

Manchester Polytechnic

Quality Assurance Group

OUTLINE OF THE STUDY PACKAGE

I wish to order/discuss the following

Tel: 061 228 6171 Ext 2394,
or write to address overleaf.

AN INTRODUCTION TO QUALITY ASSURANCE

Six Study Guides — per set £168

1. The Need for Quality Assurance
2. Quality and the Manufacturer
3. Quality Costs
4. Specifications and Control of Quality
5. Quality Systems to BS 5750
6. Product Liability

IMPLEMENTATION IN DETAIL

Study Guides

7. Quality Assurance and Design	£28
8. QA Plans, Programmes and Procedures	£28

INTRODUCING QA TO A SMALL COMPANY

Three Case Studies — per set £106

1. Recognising the Needs (Videotape)
2. Implementing the System (Text)
3. Controlling Materials (Videotape)

QUALITY ASSURANCE AUDITS

Four Case Studies

4. General Engineering (Text)	£28
5. Construction Industry (Text)	£28
6. Instrument Manufacture (Text)	£28
7. Light Engineering (Videotape)	£80

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The objects for which **The Further Education Unit (FEU)** is established are to promote, encourage and develop the efficient provision of further education in the United Kingdom and for that purpose:
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b) to determine priorities for action to improve the provision of further education and to make recommendations as to how such improvements can be effected;
c) to carry out studies in further education and to support investigations of and experimentation in, and the development of, further education curricula and to contribute to and assist in the evaluation of initiatives in further education;
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